

Patent claims

1. A method of severing or removing a biological structure, in particular bone, having a water-jet cutting system (R) from which a severing medium (4) under high pressure is discharged, characterized in that the severing medium (4) is discharged onto the biological structure in a pulsed manner.
2. A method of severing or removing a biological structure, in particular bone, having a water-jet cutting system (R) from which a severing medium (4) under high pressure is discharged, characterized in that a periosteum is acted upon at least partly from inside by the severing medium (4).
3. The method as claimed in claim 2, characterized in that the periosteum is acted upon by a pulsating severing medium.
4. The method as claimed in at least one of claims 1 to 3, characterized in that an organic and/or inorganic abrasive agent (5) is added to the severing medium (4).
5. The method as claimed in at least one of claims 1 to 4, characterized in that the pulsation of the severing medium (4) is produced directly before discharge in a cutting-nozzle element (S, S₁ to S₄).
6. The method as claimed in at least one of claims 1 to 5, characterized in that the pulsation is produced by a

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pulsating, possibly alternating, pressure change of the severing medium (4) to be discharged.

7. The method as claimed in at least one of claims 1 to 6, characterized in that the pulsation in the cutting-nozzle element (S, S₁ to S₄) is produced mechanically, pneumatically, electromagnetically according to the piezoelectric effect, or electromagnetically, any desired frequency of the pressure change being set.

8. The method as claimed in at least one of claims 1 to 7, characterized in that the pulsation is produced by utilizing the effect of the increase in the flow velocity of the severing medium in a gap or annular gap (16) while at the same time reducing the pressure and reducing the size of the gap by means of a movable shut-off part (14) which is moved by the vacuum and an energy-storing element which opens the gap again at zero gap and at zero flow.

9. A water-jet cutting system for severing or removing a biological structure, in particular bone, having a pressure-generating device (1) to which at least one cutting-nozzle element (S, S₁ to S₄) can be connected, characterized in that a supply reservoir (2) having at least one introduced severing medium (4) is assigned to the pressure-generating device (1) in an interchangeable manner.

10. The water-jet cutting system as claimed in claim 9, characterized in that at least one cutting-nozzle element (S,

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S₁ to S₄) can be connected to the supply reservoir (2), in particular to a pressure space (3).

11. The water-jet cutting system as claimed in claim 9 or 10, characterized in that the pressure-generating device (1) has a linear drive (7), in particular an electromechanically operated linear actuator, which applies pressure to a plunger element (6) of the supply reservoir (2).

12. The water-jet cutting system as claimed in at least one of claims 9 to 11, characterized in that the supply reservoir (2), via at least one quick-acting lock (8), if necessary as a thread or as a bayonet lock, is connected to the pressure-generating device (1) in such a way that it can be released again.

13. The water-jet cutting system as claimed in at least one of claims 9 to 12, characterized in that at least two pressure-generating devices (1) having interchangeable supply reservoirs (2) can be connected to one cutting-nozzle element (S, S₁ to S₃), either the one or the other pressure-generating device (1) delivering the severing medium (4) to the cutting-nozzle element (S, S₁ to S₃).

14. A cutting-nozzle element for severing or removing a biological structure, in particular bone, to which a severing medium (4) under pressure can be fed, characterized in that at least one nozzle opening (13) is provided at the end face or radially in a cutting-nozzle body (12).

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15. The cutting-nozzle element as claimed in claim 14, characterized in that at least one shut-off element (14) for the pulsed closure of the nozzle opening (13) is assigned to the cutting-nozzle body (12).

16. The cutting-nozzle element as claimed in claim 15, characterized in that the shut-off element (14) is arranged inside the nozzle body (12).

17. The cutting-nozzle element as claimed in claim 15 or 16, characterized in that the shut-off element (14) is arranged inside the nozzle body (12) in such a way that it can be moved in a translatory and/or rotational manner, in particular in a reciprocating manner.

18. The cutting-nozzle element as claimed in claim 17, characterized in that the nozzle opening (13) can be closed at intervals in a pulsed manner by the translatory and/or rotational movement of the shut-off element (14).

19. The cutting-nozzle element as claimed in at least one of claims 15 to 18, characterized in that a gap or conical annular gap (16), through which the severing medium (4) flows, is formed in between cutting-nozzle body (12) and shut-off element (14).

20. The cutting-nozzle element as claimed in at least one of claims 15 to 19, characterized in that, to draw off severing medium and biological substances, the shut-off element (14)

is designed like a hollow shaft and projects at the end face from the cutting-nozzle body (12).

21. The cutting-nozzle element as claimed in at least one of claims 15 to 20, characterized in that the shut-off element (14) is provided with a shaft shoulder (18) which closes the nozzle opening (13) and to which pressure is applied axially by means of an energy-storing element (19).

22. The cutting-nozzle element as claimed in at least one of claims 15 to 21, characterized in that an elastic tube element (22) adjoins the shut-off element (14) for drawing off and compensates for a translatory and/or rotational movement of the shut-off element (14).

23. The cutting-nozzle element as claimed in at least one of claims 15 to 22, characterized in that a rotatable shut-off element (14) is inserted into the cutting-nozzle body (12).

24. The cutting-nozzle element as claimed in claim 23, characterized in that a severing medium (4) is fed to the shut-off element (14), which has at least one radial or axial discharge opening (13), which can be moved by rotation and/or translation to a coinciding nozzle opening (13) of the cutting-nozzle body (12).

25. The use of components of the common-rail injection technology, in particular for pressure generation, valve technology and electronic control for a water-jet cutting system and/or a cutting-nozzle element.

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